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Wireless Automatic Meter Reading System Based On Next Generation Broadcasting

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Abstract

The paper introduces a wireless automatic meter reading system based on next generation broadcasting (NGB) and its control method. The system includes information collection, transmission and processing modules. The information collection module is responsible for collecting the data of the meter of water, electricity or gas, and sending the collected information to information transmission module. Then the information transmission module will send the data information to the processing center through the short range wireless communication and two-way television cable network. The information processing module then sends the collected information to the network processing center. Information processing center can communicate with the information transmission module and control the data acquisition, transmission and other operations of the three meters over the two-way cable television network. The system uses the existing set-top box or digital TV interface to access the wireless transceiver module, the user interface can use the existing interactive TV platform, users can query the information of the three meters, the payment and bill through TV sets.

Keywords: NGB, wireless meter reading, interactive TV;

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1. Introduction

With the evolution of the residential area to the intelligent direction and the growing demand for the living environment, improving the construction Intelligent Community has become an important task. Automatic meter reading system is an indispensable part of intelligent residential construction. Automatic meter reading systems mainly include palm, wired and wireless meter reading system. Compared to the cable meter-reading system complexity and handheld meter reading system of low automation, wireless meter reading system reduces the consumption of manpower and materials and the system has the advantages of simple structure, easy to realize[1]. The domestic existing wireless meter reading systems which we know very well, are mainly based on the telecom mobile network, and mobile phone terminal is needed in the development data module for data receiving and processing. They all have large power consumption and high cost. Another based on a small range of wireless meter reading system, requires the development of table end wireless module, and residential roof wireless transceiver system communication, and specialized personnel for meter reading, a waste of human and poor reliability[2].

Based on this, we propose a method based on the NGB wireless automatic meter reading system, through the STM32F103 and NordicRF24L01 design of wireless channel, the low power consumption condition completely automatic meter reading, automatic charging, and consumers can use the remote controller and television for three table data, previous payment and bills and other inquiries.

2. The overall design of system

2.1. System overview

The NGB-based wireless automatic meter reading system which innovatively uses the feedback function of next generation of broadcasting, using intelligent set-top box, a general purpose computer system, a two-way digital television network and database technology, to overcome the traditional wireless meter reading system with high cost, high power consumption and the problem of waste of resources, achieves the three tables of data collection, processing, transmission and storage.

The system is mainly composed of three table information acquisition device, information receiving and transmitting device and information processing device. The information acquisition device includes three tables, collecting module and a wireless module. The information receiving and transmitting device comprises a wireless module and digital television set-up box. The information processing device is the digital television user information and business management system. The overall structure is showed in Fig 1.

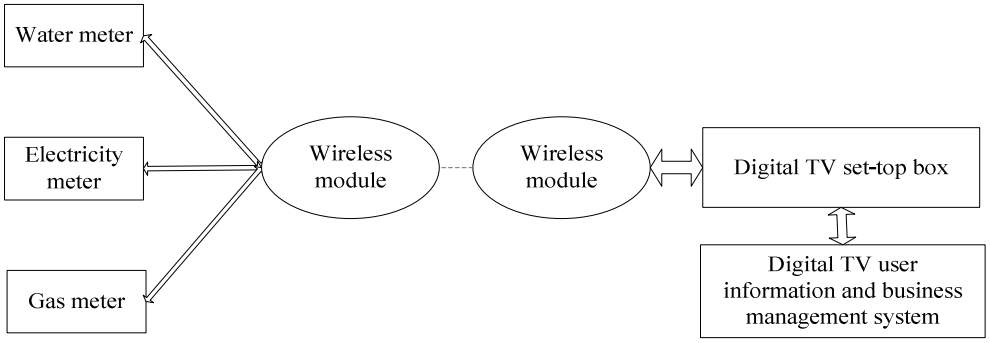

Fig. 1. frame diagram of system

The system uses two kinds of reading: active and passive meter reading meter reading. Active reading method: The lower module of a timing acquisition meter flow and abnormal information, transfer information to the upper module through the wireless module; the upper module process the information, and calculate costs through digital television information and business management billing and management system. Passive reading method: When the upper module receives a user reading instruction, through the wireless communication between the modules, it sends instruction to down layer module; the lower module collects the meter data and return back to the upper module according to the received instruction; the upper module will transport the received meter data to the information processing device with digital TV set-top box[3].

2.2. Work principle of system

The information acquisition device, using the collection module installed on three tables-sides, collects the three tables flow information and three table-sides exception information.

The information transmitting and receiving device will receive the above three table information wirelessly, and transport these messages to information processing device through radio and television cable two-way network.

The information processing device, as the information processing center on internet, processes the messages and calculates the meter costs and transmits it to the digital TV set-top box of the information transmitting and receiving device; the user can display real time query information.

3. System hardware design of meter reading terminal

System of the short distance wireless transmission system mainly consists of two wireless modules, one is in the information acquisition device, receiving the meter reading instruction of the upper module, for transmitting the acquisition meter information of acquisition end; one is in the information transmitting and receiving device, to pass the upper transmission meter reading instruction to the lower module, and receive the lower module return to the supply information..

The system uses a low power but high performance microprocessor STM32F103 and wireless chip NordicRF24L01 to design of short distance wireless transmission system.

The microprocessor stm32f103 with the Cortex-M3 kernel, has the advantages of low power consumption, low voltage and high performance characteristics, at the same time with a high degree of integration and easy development advantage[4].

The wireless chip NordicRF24L01, a new single-chip RF transceiver, can operate in the 2.4GHz ~ 2.5GHz ISM band, built-in frequency synthesizer, power amplifier, crystal oscillator, modulator and other functional modules with the integration of enhanced ShockBurst technology, in which the output frequency and communication channels can be configured through the process. The transceiver has low power consumption, when launching, the working current is only 9mA; When receiving, the working current is only 12.3mA. Multiple low power modules (power off mode and an idle mode) allows the energy-saving design more convenient[5].

Short distance wireless transmission system is showed in Fig 2. SPI serials are used for linking the controller and chip.

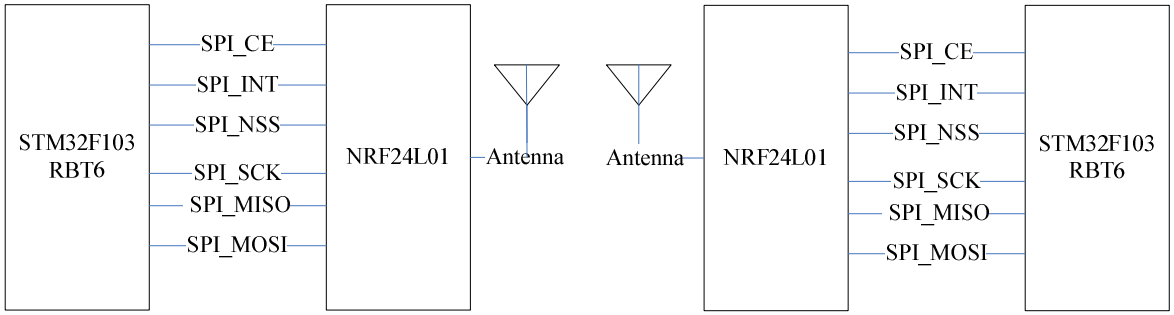

Fig. 2. short distance wireless transmission system

As shown above, the left side connects with the three tables' acquisition end for collecting meter information; the right side connects with the digital TV set-top box for receiving the instruction from the upper module. Module on the right side switches on the digital TV set-top box using the box's existing interface access, while the user interface will follow the traditional TV interactive payment system, good use of existing resources.

4. The software design of the system

4.1. The upper module software design

The upper module is divided into two aspects.

One aspect, the system takes the digital TV set top box interface program development, for the wireless module directly with STB existing interface to realize interconnection to provide a convenient. The second development is the need for set-top box application, processing the received data information, and through wired radio and television cable two-way transmission network for transmission to the information processing device. Back-end billing platform software development is also needed.

On the other hand, when the system is powered up, the NordicRF24L01 status word is initially configured. The set-top box interface end of the micro-controller receives the meter reading information send by the information processing device, and transmits instruction to the information acquisition device with the mode of wireless communication. If the lower module does not return or return error information, the upper NordicRF24L01 resend the directive[6].

4.2. The lower module software design

First activate the lower module, when the upper module sends the meter reading instruction, the micro-controller first checks the address match. If the error, then continue to wait for the new instruction. If correct, the upper module command is sent to the meter, and the acquisition device collects meter data. After receiving data, the lower module returns data back to the top through NordicRF24L01 RF transceiver, and then continue to wait for the upper module instruction.

4.3. Wireless communication protocol

Because the job is in indoor radio environment, the wireless environment is more complex, so the reliable wireless communication will be dependent on the high reliability of wireless communication protocol. We

will develop the communication protocol according to the radio channel characteristics of the test, including the frame structure, error correction methods, access methods, handshake, etc[2].

5. System advantages

- Three table ends adopts a miniature battery power supply, so the seal greatly reduces risk. Miniature battery power supply need only circuit work very low current, so the battery can work continuously for several years without change.
- Using the existing high quality, high transmission reliability of radio and television cable two-way transmission system, the operation cost is greatly reduced and the resources is greatly saved.
- Smart terminal of wireless transceiver module can be done very low power consumption. Because the home based on wireless communication network ranges hundreds of meters to several kilometers, but based on CATV network for wireless transmission distance in only one family range, so the transmission power is reduced greatly.
- The system provide some substantive applications for the radio and television NGB, and provides research basis and feasibility verification for radio and television services Home Networking, namely for broadcasting and television network business development to provide a starting point[2].

6. Conclusion

Facing the NGB family Internet application environment, this paper puts forward a wireless automatic meter reading system, including information collection, transmission and processing device, through a combination of radio and television cable two-way transmission networks and short distance wireless sensor network , low power consumption, low cost to complete the reading function. The system is proposed in the overall context of the triple play and the Internet of Things, and provides a number of substantial applications for NGB, but also provides research basis and feasibility for the marching home networking.

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